TITLE OF INVENTION

Multi-function Animal Training Transmitter

CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable.

BACKGROUND OF THE INVENTION

1. Field of Invention

[0001] This invention pertains to an electronic animal training apparatus that allows a trainer to remotely correct the behavior of animals. More particularly, this invention pertains to a hand-held transmitter used by a trainer having a keypad that can be reprogrammed to be used with a variable number of animals and for various training objectives.

2. Description of the Related Art

[0002] Electronic animal training devices are an effective tool for correcting the behavior of animals. Professional trainers widely employ electronic animal training to prepare animals for a task. A common example is the training of sporting dogs to retrieve game. A professional trainer generally performs a variety of training methods and works with a large number of animals on a regular basis. Because of this, trainers are required to utilize more than one electronic training apparatus in performance of their duties.

[0003] The necessity of multiple electronic training devices unnecessarily

increases the complexity of training. A trainer must maintain a variety of matched transmitter and receiver collar pairs to accomplish different training functions. Even when the products are all supplied by the same manufacturer, there is no assurance that interoperability between the devices was contemplated.

[0004] As training progresses, the method employed by the trainer may change to best tailor the training program to the animal. If the change to the training program involves a change in the electronic training apparatus facilitating the training, the trainer must cease training and swap the training device in use. The change may simply involve swapping the transmitter unit for another, but it may also require the receiver unit to be traded out for another that is paired with the new transmitter.

[0005] Accordingly, it is desirable to use a transmitter and receiver collar pair where the function of the transmitter can be altered as desired by the trainer. This would eliminate the need for having multiple transmitter and receiver collar pairs available to the trainer.

BRIEF SUMMARY OF THE INVENTION

[0006] An apparatus adapted to implement various animal training techniques using a hand-held transmitter having a keypad that can be reprogrammed, or multi-function transmitter, is shown and described. The multi-function transmitter is configurable to train multiple pets using a selected function or to train a single pet using multiple functions.

[0007] The circuit includes a processing device that controls the major functions of the multi-function transmitter. The circuit of the present invention further includes a number of other components in communication with the processing device. A power subsystem includes a power source in electrical communication with a power protection circuit, a voltage regulator, and a low power detection circuit. The low power detection circuitry communicates with the processing device to provide indication to the user of the need to replace or charge the power source.

[0008] A number of control switches are in electrical communication with the processing device. The training control switches are assigned functions based upon the selected mode, which is selected via a separate button. The multi-function transmitter typically includes another control switch from which unique values can be read thereby allowing the processing device to set a variable characteristic. The processing device communicates information to the operator through at least one indicator. A communication subsystem in communication with the processing device transmits information from the multi-function transmitter to a receiver unit carried by the animal being trained. An amplification and filtering stage provides additional signal processing before transmitting the modulated carrier wave.

[0009] The multi-function transmitter of the present invention operates generally as follows. Initially, the multi-function transmitter is initialized. Subsequently, the multi-function transmitter polls for a user input. If the mode control button is pressed, the multi-function transmitter enters a mode selection function. If the mode control button is not active, the system enters a training mode. First, the training mode is initialized. Next, functions are assigned to the upper control button and lower control button based upon the selected mode. When either of the upper control button and lower control button is activated, the function currently associated with the button is processed and a data packet for the training signal is generated. The training signal, including the data packet containing function information, is transmitted. The system then loops looking for continued activity on the control buttons and responds accordingly.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0010] The above-mentioned features of the invention will become more clearly understood from the following detailed description of the invention read together with the drawings in which:

Figure 1 is a block diagram of a circuit for a multi-function transmitter;

Figure 2 is a flow diagram of a method for implementing the remote transmitter of Figure 1;

Figure 3 is a flow diagram illustrating one embodiment of the system

initialization function of the multi-function transmitter;

Figure 4 is a flow diagram illustrating one embodiment of the training mode selection function for the multi-function transmitter;

Figure 5 is a flow diagram illustrating one embodiment the training mode initialization function of the multi-function transmitter;

Figure 6 is a flow diagram illustrating one embodiment of the button assignment function of the multi-function transmitter;

Figure 7 is a flow diagram illustrating one embodiment of the selected button procession function of the multi-function transmitter;

Figure 8 is a flow diagram illustrating one embodiment of the training signal transmission function of the multi-function transmitter;

Figure 9 is a flow diagram illustrating one embodiment of the power saving function of the multi-function transmitter; and

Figure 10 is a flow diagram illustrating one embodiment of the timer update function of the multi-function transmitter.

DETAILED DESCRIPTION OF THE INVENTION

[0011] An apparatus adapted to implement various animal training techniques using a hand-held transmitter having a keypad that can be reprogrammed, or multi-function transmitter, is shown generally at **10** in the figures. The multi-function transmitter is configurable to train multiple pets using a selected function or to train a single pet using multiple functions.

[0012] Figure 1 illustrates a block diagram of one embodiment of a circuit of the present invention. The circuit includes a processing device **100** that controls the major functions of the multi-function transmitter **10**. In the illustrated embodiment, the processing device **100** is a microcontroller including electrically erasable programmable read-only memory (EEPROM) and an interrupt on change feature. One microcontroller incorporating the desired features is the PICmicro™ 16CE625 from Microchip Technology, Inc. Those skilled in the art will recognize that other processing devices capable of providing the required control logic can be used without the departing from the scope in spirit of the present invention. The circuit of the present invention further includes a number of other components in communication

with the processing device **100**. A power subsystem **102** includes a power source **112**, such as a battery, in electrical communication with a power protection circuit **114**, a voltage regulator **116**, and a low power detection circuit **118**. The low power detection circuitry **118** communicates with the processing device **100** to provide indication to the user of the need to replace or charge the power source **112**.

[0013] A number of control switches **104** are in electrical communication with the processing device **100**. Shown in Figure 1 are an upper control button **120**, a lower control button **122**, a mode control button **124**, and a correction intensity switch **128**. The switches described herein represent one embodiment of the present invention. However, variations in the type and number of the switches can be made without departing from this scope in spirit of the present invention depending upon the intended objectives of the device. In one embodiment, the upper control button **120**, the lower control button **122**, and the mode control button **124** are normally open push button type switches and the correction intensity switch **128** is a multi-position rotary switch. A counter **126** provides a number of unique outputs. Each unique counter output drives one input of the multi-position rotary switch. This allows the processing device **100** to read unique values from the correction intensity switch and select a variable characteristic, which is described herein as the desired intensity level for the correction stimulus. Those skilled in the art will recognize that functions other than correction intensity control can be substituted without departing from the scope and spirit of the present invention.

[0014] The processing device **100** communicates information to the operator through at least one indicator **130** In one embodiment, the indicator **130**includes a number of light emitting diodes (LEDs), which are flashed to provide such information as the activation of the upper control button **120** or the lower control button **122** and the current mode setting. Those skilled in the art will recognize that more sophisticated indicators can be implemented without departing from the scope in spirit of the present invention. For example multi-segment LEDs or a liquid crystal display can be used to provide easier to interpret or more detailed communication as desired.

[0015] A communication subsystem **108** in communication with the processing device **100** transmits information from the multi-function transmitter **10** to a receiver unit carried by the animal being trained. In the illustrated embodiment, the communication subsystem **108** includes a modulator **132**, an oscillator **134**, and an on/off control **136** in communication with the processing device **100** for generating a modulated carrier frequency containing information about the type of the correction stimulus to be applied by the receiver unit. The present invention operates in the radio frequency band using approved communication frequencies. Radio frequency communications and the appropriate modulation schemes are well known to those skilled in the art.

[0016] An amplification and filtering stage **110** provides additional signal processing before transmitting the modulated carrier wave. In the illustrated embodiment, the amplification and filtering stage **110** includes a buffer amplifier **138**, a power amplifier **140**, and a bandpass filter **142** connected to the broadcast antenna **144**. Again, those skilled in the art will recognize that the implementation of the amplification and filtering stage **110** depends upon the design objectives for the device.

[0017] The block diagram of Figure 1 illustrates the major components of the circuit for the multi-function transmitter **10**. It is not intended to illustrate basic connections and components, for example, power and ground connections and other standard components, such as pull-up resistors. Those skilled in the art will recognize the need for such wiring and components and will recognize the proper interconnection required to implement the invention described herein without undue experimentation based on the components selected for use.

[0018] Figure 2 is a flow diagram of the method of operating the multi-function transmitter **10** of the present invention. Initially, the multi-function transmitter **10** is initialized **202**. Subsequently, the multi-function transmitter **10** polls for a user input **204**. If the mode control button **124** is pressed, the multi-function transmitter **10** enters a mode selection function **208**. If the mode control button **124** is not active, the system enters a training mode. First, the training mode is initialized **210**. Next,

functions are assigned to the upper control button **120** and lower control button **122** based upon the selected mode **212**. When either of the upper control button **120** and lower control button **122** is activated, the function currently associated with the button is processed and a data packet for the training signal is generated **214**.. The training signal, including the data packet containing function information, is transmitted, step **216**. The system then loops looking for continued activity on the upper control button **120**, the lower control button **122**, or the mode control button **124** and responds accordingly.

[0019] Figure 3 illustrates the steps involved in initializing the system **202** in greater detail. The multi-function transmitter **10** sets up the systems ports **300**. The multi-function transmitter **10** then decides if it is responding to a power-on reset **302**. In the case of a power-on reset, the system enters a long sleep **900**. If not, the registers are initialized **304** and the overcorrection timer is initialized **306**. Next, the radio transmitter is turned on **308**. After a delay **310**, the current training mode is read **312**. The current mode is verified to be a valid mode **314**. If the mode is invalid, the training mode is reset to a selected valid mode **316**. Once a valid mode is selected, the operation continues looking for user input **204**.

[0020] Figure 4 illustrates the steps involved in selecting a training mode **208** in greater detail. After the mode control button **124** is activated, the multi-function transmitter **10** indicates the current mode to the user **400**. Those skilled in the art will recognize the various methods and structures that can be used to indicate the current mode to the user without departing from the scope and spirit of the present invention. The multi-function transmitter **10** determines whether the mode control button **124** is held for a specified length of time **402**. If the required activation time is met, the mode number is incremented **404** and the operation returns to step **400**, which indicates the new mode to the user. Should the multi-function transmitter **10** be unable to determine whether the mode control button **124** has been held for the required time, a debounce function **406** is applied to the mode control button **124** and the activation status of the mode control button **124** is checked again **408**. If the mode control button **124** remains active, the mode selection cycle is not complete and operation returns to step **402**, which again determines the activation time of the mode

control button **124**. If, in step **408**, the mode control button **124** is determined to not be active, then the current mode number is stored **410** and the multi-function transmitter **10** enters a long sleep cycle **900**.

[0021] Figure 5 illustrates the training mode initialization **210** in greater detail. Following the long sleep cycle **900**, the watchdog timer is reset **500**. Next, the power source **112** is checked for sufficient voltage to ensure proper operation of the multi-function transmitter **10** and the value of the LED timer is compared to a reference value **502**. If the multi-function transmitter **10** is determined to be ready for operation, the operation indicator **130** is activated **506** otherwise the operation indicator **130** is deactivated **504**. Next, the multi-function transmitter **10** verifies that the overcorrection timer has not expired **508**. If an overcorrection condition is indicated, the multi-function transmitter **10** determines whether any control button **120**, **122** is active **514**. While the control button **120**, **122** remains active, the update timers function **1000** repeats. Once the control button **120**, **122** is released, the multi-function transmitter **10** enters the long sleep cycle **900**. Following the long sleep **900**, the multi-function transmitter **10** reinitializes the system **202**. If an overcorrection condition does not exist, the correction intensity setting is read **510** from the correction intensity switch **128 128**. The correction intensity is then stored for later use **512**.

[0022] Figure 6 illustrates the button function assignment **212** in greater detail. The multi-function transmitter **10** determines if the lower control button **122** is active **600**. If the lower control button **122** is active, the current mode number is converted to a value for inclusion in the transmission signal **602**. Next, the current mode value is checked to determine whether the multi-function transmitter **10** is operating in a multi-dog training mode **604**. If the current mode is a multi-dog training mode, the activation of the lower control button **122** represents a training command sent to a second dog. Accordingly, the identification value for the training collar carried by the secondary dog is stored as the identification value for inclusion in the transmission data packet **606**. If operating in a single dog training mode, the identification value for the training collar carried by the primary dog is stored as the identification value for inclusion in the transmission data packet **608**. After the identification value

associated with the lower control button **122** is determined, operation continues to the selected button processing function **214**.

[0023] If the lower control button **122** is not active, the multi-function transmitter **10** determines if the upper control button **120** is active **610**. If active, the identification value for the training collar carried by the primary dog is stored as the identification value for inclusion in the transmission data packet **612**. The current mode number is converted to a value for inclusion in the transmission signal **614**. Next, the multi-function transmitter **10** determines whether changes should be made to the correction intensity **616**, **620**. The multi-function transmitter **10** identifies whether the current mode is the maximum correction mode **616**. If the maximum correction mode is selected, the correction intensity value is set to the maximum **618**. If not the maximum correction mode, the multi-function transmitter **10** determines whether the increased correction intensity mode is selected **620**. If the increased correction intensity mode is selected, the correction intensity value is increased **622**. After any changes to the correction intensity have been made, operation continues to the selected button processing function **214**. If neither of the upper control button **120** or the lower control button **122** is active, the multi-function transmitter **10** enters a long sleep cycle **900**.

[0024] Figure 7 illustrates the selected button processing function **214** in greater detail. The multi-function transmitter **10** determines if the training mode or the correction intensity level has been modified **700**. If a modification has occurred, a delay is introduced **710** The transmission data packet is built. The unit ID is added into the transmission data packet **702**. The target identification value is loaded into the transmission data packet **704**. The training mode value is loaded into the transmission data packet **706**. The correction intensity value is loaded into the transmission data packet **708**. Those skilled in the art will recognize that the order in which the transmission data packet is built can be varied without departing from the scope and spirit of the present invention. Once the transmission data packet is built, operation continues to the training signal transmission function **216**.

[0025] Figure 8 illustrates the training signal transmission function **216** in greater detail. First, the transmission data packet is broadcast **800**. The multi-function transmitter **10** determines whether the current training mode is a NIC correction mode **802**. If not a NIC correction mode, the overcorrection **timer** is updated **804**. The multi-function transmitter **10** then determines whether the transmission is the initial transmission for a particular training signal. If the transmission is not the first transmission, the timer update function is applied **1000**. Following the timer update function **1000** or, if the transmission was the first transmission, operation returns to the training mode initialization function **210**. When the training mode is a NIC correction mode, the communication subsystem **108** is temporary deactivated to prevent further transmissions **808**. The LED timer is initialized **810.** The multi-function transmitter **10** monitors activity on the buttons **812**. While any button is pressed, the update timers function is applied **1000**. After all buttons are released, the long sleep function **900** is applied.

[0026] Figure 9 illustrates the long sleep function **900** in greater detail. The long sleep begins with a delay **902**. Next all input port pins are set to a default value **904**, for example, all port pins are set low. Next, the EEPROM is turned off **906**. The interrupt flags are cleared **908** on the processing device **100** and then the interrupts are enabled **910**. A prescaler is applied to watchdog timer **912** to adjust the length of time that the multi-function transmitter **10** operates before resetting. The change interrupt port is read **914**. The multi-function transmitter **10** enters a sleep mode **916** for low current consumption when not in use. Next, the multi-function transmitter **10** determines whether a change has occurred on the interrupt port from the last reading of the interrupt port **918**. This allows implementation of waking the multi-function transmitter **10** on key-depression. If no change has occurred, the multi-function transmitter **10** determines whether a watchdog timer interrupt has occurred **920**. If a watchdog timer interrupt has not occurred or a change interrupt has occurred, the change interrupt is disabled **922** and the interrupt flags are cleared **924**. However, if a watchdog timer interrupt occurs, the long sleep function **900** repeats.

[0027] Figure 10 illustrates the update timers function **1000** in greater detail. The multi-function transmitter **10** determines whether the LED timer has expired **1002**. When the LED timer expires, the operation indicator **130** is turned off **1004**. If the LED timer has not expired, the LED timer is updated **1006**.

[0028] Those skilled in the art will recognize that the flow diagram illustrated in Figures 2-11 represent one embodiment of the button function assignments that can be made using the present invention.

[0029] From the foregoing description, it will be recognized by those skilled in the art that a multi-function training transmitter has been provided that, in the foregoing embodiment, allows in-the-field modification of the training method without the changing of the transmitter and receiver pair. By being field reprogrammable, the multi-function trainer provides access to a variety of training methods from a single transmitter unit and can be programmed for use with one or more animals, depending upon the training session. Although described in reference to two animals, those skilled in the art will recognize that the transmitter is easily adaptable to handle any number of animals, the major limiting factors being the cost, size, and complexity of the transmitter layout. Such a layout might employ additional buttons for each additional animal or use a multi-function technique such as a shift button in the manner of the shift, CTRL, and ALT keys found on conventional keyboards.

[0030] While the present invention has been illustrated by description of several embodiments and while the illustrative embodiments have been described in detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept.